DUSTS and SPRAYS For Vegetable Insects

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THE PURPOSE of this publication is to give commercial vegetable growers and home gardeners up-to-date information for use against insects that damage vegetable crops. It does not describe these insects, nor does it give their life histories to any extent. For information concerning identification and life histories, see Illinois Circular 671, entitled *Common Vegetable Insects*. Write College of Agriculture, University of Illinois, Urbana, for free copy.

GENERAL CONTROL MEASURES

Insect control is too often thought of only as spraying or dusting; that is, as the use of insecticides. Several other practices, however, that require little or no expense help materially to reduce insect damage.

Destroy insect breeding places. Weeds, crop wastes such as old cabbage stalks or melon vines, neglected fence rows, ditch banks, and neglected hotbeds and cold frames, all serve as breeding places for garden insects and protect them during the winter. Plow under, compost, or burn these crop remnants as soon as possible after harvest. Don't let weeds grow in or near the garden.

Choose resistant varieties. Resistant varieties are not weakened by insect attack. When conditions are unfavorable, they

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are therefore more likely to produce profitable crops than nonresistant varieties. Then too, insecticides are normally more effective on resistant varieties. Any varieties you choose should, of course, be adapted to your locality.

Rotate crops. Group related crops — such as cabbage and cauliflower, cucumber and squash, potato and tomato — and plant them in a different location every year. Don't follow early radishes by cabbage, nor cabbage by radishes. These two crops are subject to attack by the same insects. Even home gardeners sometimes need to choose a new location when insects have become very troublesome.

Use best cultural practices. Good cultural practices will reduce, both directly and indirectly, the number of insect pests. Plowing destroys insects that live in the soil, such as white grubs and wireworms. Keeping down the weeds and grass on which cutworm moths lay their eggs often reduces cutworm damage. Frequent cultivation controls, at least partially, some of the flea beetles.

Also, plants kept in a thrifty, growing condition will tolerate a moderate infestation of insects without serious injury and will recover more rapidly than unthrifty plants.

HOW INSECTS FEED

Insects are grouped into two general classes according to their feeding habits: chewing insects and sucking insects.

Typical chewing insects are cabbage worms, grasshoppers, and flea beetles. Since they eat out pieces of plant tissue, the injury chewing insects do can be easily seen. The plant tissue they eat eventually reaches their stomachs, so that an insecticide put on the stems and leaves will also find its way into their digestive systems. Such poisons are usually called *stomach poisons*. DDT, rotenone, and parathion are common stomach poisons.

Typical sucking insects are aphids, leafhoppers, and squash bugs. Sucking insects insert their needlelike beaks into the plant tissue and suck out the plant juices in much the same way that

a mosquito punctures the skin and draws out blood. The wounds they make are seldom easy to see. The crops they feed on, however, may become badly deformed, or wilt and die prematurely.

Little or none of the surface tissue of the leaf or stem reaches the stomach of sucking insects. Consequently an insecticide must be used that will kill these insects when it comes in contact with their bodies or appendages. Such poisons are called *contact poisons*. Typical contact poisons are nicotine, rotenone, DDT, and parathion. Some of these also act as stomach poisons.

INSECTICIDES FOR VEGETABLE INSECTS

Because they are highly poisonous to both chewing and sucking insects, some of the newer insecticides have the reputation of being general-purpose insecticides. But even the best of these — rotenone, DDT, and parathion — will not control *all* the insects commonly found on garden vegetables. Other insecticides, more limited in their effect, may be needed.

General Purpose Insecticides

Rotenone is derived from the roots of certain tropical plants. It can be used on vegetables with little danger of injuring the plants or of leaving a residue poisonous to people. Though it is effective against many insect pests, rotenone usually fails to give the high degree of insect control that such synthetic insecticides as DDT afford. The Mexican bean beetle, however, is very susceptible to it.

Rotenone is commonly sold as a 0.5-to-1.0-percent dust. Emulsifiable rotenone concentrates are available for spraying. They should be used according to directions of the processor.

DDT, a synthetic insecticide, acts as both a contact and a stomach poison. Its residues on vegetables remain poisonous to insects for an extended period. DDT decomposes slowly and therefore should not be used on the edible portions of vegetables near harvest time.

DDT is made in two grades — technical and refined (also called aerosol). Technical DDT is injurious to vine crops (cu-

cumbers, squash, etc.), especially when it is applied as a spray. Refined DDT is less injurious to such crops, yet equals technical DDT as an insect poison.

DDT dusts are sold in 3-, 5-, and 10-percent concentrations. Wettable DDT powder and emulsifiable concentrates are available for spraying. Most wettable powders contain 50 percent DDT, but recent developments indicate the possibility of using one containing 90 percent or more. Emulsion concentrates contain 25 to 34 percent.

Parathion, a new phosphate insecticide, has shown unusual promise for the control of many vegetable insects. Though it is being offered for sale at the present time, there is still much to learn about it — what its dosage should be, what insects are susceptible to it, and what its hazards to plants and animals are.

We do know that PARATHION IS A DEADLY POISON. Because of the dangers to those handling or applying it, it is not recommended for general use. Even though highly effective for many purposes, it should not be used where a safer material will give satisfactory control. Its use is justified only when a situation definitely demands it and when the operator is in a position to use or enforce all the proper precautions.

From the standpoint of the operator, wettable parathion powder in a water spray is the safest form of application. Wettable powders usually contain 15 percent of parathion and are used at the rate of 1 to 2 pounds to the acre. Parathion dusts containing 0.5 to 1 percent of the toxicant are available. But if you use them, you must take special precautions to protect yourself or your operator.

If you are making extensive applications of parathion, you must wear a good dust mask and protective clothing. Take these clothes off as soon as you can and take a bath or a shower.

Do not use parathion on the edible parts of vegetables within 30 days of harvest.

Special Purpose Insecticides

Nicotine sulfate (40-percent) is highly effective against aphids. In instances in which DDT does not control aphids, it can be combined with DDT sprays. Water sprays are commonly

made with 1 to 2 pints of 40-percent nicotine sulfate in 100 gallons of water. Six pounds of soap must be added to such a spray to activate the nicotine.

Nicotine dusts can be prepared at home by mixing nicotine sulfate with hydrated lime. To make a 3-percent nicotine dust, thoroughly mix 3 pints of nicotine sulfate with 50 pounds of hydrated lime in a tight container. Several small stones in the container will help to get even mixing. *Do not breathe the nicotine fumes from the mixture.*

Nicotine dusts and sprays are not effective against aphids unless the temperature is above 70° F.

Pyrethrum is obtained from the flowers of certain plants. To insects it is primarily a contact poison. Residues remaining on plants are not considered hazardous to man. Pyrethrum extracts (pyrethrins) are prepared as dusts and liquid concentrates for spraying. DDT has largely replaced pyrethrum.

Tetraethyl pyrophosphate (TEPP), a new phosphate insecticide, is a highly effective contact poison for aphids and red spiders. Like parathion, however, it must be handled with great care and not allowed to come in contact with the skin or eyes.

Emulsifiable concentrates for spraying are the easiest form to get. The amount of tetraethyl pyrophosphate in these preparations has not been standardized, so when using them it will be necessary to follow the recommendations of the manufacturer. *Do not use more than is recommended for specific crops since some crops may be injured by overdosing.*

Mixed sprays must be used immediately for best results. Freshly mixed dusts containing as little as 0.75 to 1.0 percent tetraethyl pyrophosphate have been used successfully against aphids.

Chlordane acts as a contact and a stomach poison. While chlordane is effective against a great many vegetable insects, it has not been used extensively in Illinois because of its relatively high cost. A few vegetable insects are more susceptible to chlordane than to other insecticides, and in such cases its use is justified. Grasshoppers, cabbage maggots, and white grubs are examples of insects more easily killed with chlordane than with the

older insecticides. Chlordane is available as a low-concentration dust and as a wettable powder and emulsifiable concentrate for spraying.

Methoxy DDT is less injurious to vine crops than technical grade DDT and has shown some promise for control of the Mexican bean beetle. It is a chemical analog of regular DDT. Generally it is less poisonous than ordinary DDT to vegetable insects.

Toxaphene is very effective against grasshoppers, but has no insecticidal advantage to warrant its general use in the vegetable garden.

TDE (DDD) is a chemical relative of DDT, but it usually has no advantage over DDT in the control of vegetable insects.

Benzene hexachloride is a highly effective contact and stomach poison but is not recommended for vegetable insects because it has been shown to taint food crops. Lindane (99-percent gamma isomer of benzene hexachloride) is a recently developed insecticide that may prove to have some value in vegetable insect control.

Ryania is recommended for the control of the European corn borer, but not for other vegetable insects. It is derived from the stems of certain tropical plants. Ryania is sold most commonly as a 40-percent dust.

Sabadilla is another insecticide derived from plants. It is effective against many sucking insects, particularly the squash bug. Because of its limited use, it is not readily available from local distributing agencies.

DUST AND SPRAY FORMULAS

The charts on the following pages give dust and spray formulas for use on large plantings. For home gardeners who need a smaller amount of spray, a table of measurements is given on page 7. This table will show how the measurements given in these formulas can be adjusted to lots of spray as small as a gallon.

Suppose you want to make a gallon of nicotine sulfate spray for aphids. First look up *aphids* in the chart on page 8 and write down the nicotine sulfate spray formula (1 to 2 pints of 40-percent nicotine sulfate in 100 gallons of soapy water). Then turn to the table below. Find 1 pint in the 100-gallon column and its equivalent in the 1-gallon column: 1 teaspoon. Therefore use 1 to 2 teaspoons of nicotine sulfate in 1 gallon of the spray.

No adjustment of dust formulas is necessary for home gardens. Thorough coverage with dusts as with sprays is, however, desirable.

MEASUREMENTS FOR SMALL QUANTITIES OF SPRAY

(Based on formulas for 100 gallons)

For 100 gal.	For 25 gal.	For 5 gal.	For 1 gal.
1 gal.	1 qt.	13 Tb.	3 Tb.
1 qt.	1 cup	3 Tb.	2 tsp.
1 pt.	½ cup	1 ½ Tb.	1 tsp.
1 lb.	¼ lb.	2 ½ Tb.	1 ½ tsp.
2 lb.	½ lb.	5 Tb.	1 Tb.
3 lb.	¾ lb.	7 ½ Tb.	4 ½ tsp.

All measurements are standard and are level.
Tb. = tablespoon. tsp. = teaspoon.

DUST AND SPRAY FORMULAS FOR VEGETABLE INSECTS: Commercial Plantings

(Unless otherwise stated, use 25 to 30 pounds of dust per acre or 100 gallons of spray)

For directions for adapting amounts to home gardens, see page 7.

Insect	DUST	SPRAY	Remarks
		General Feeders on Garden Crops	
Aphids	3-percent nicotine in hydrated lime — *or* — 0.75- to 1-percent TEPP (freshly made) — *or* — 1-percent parathion — *or* — 1-percent rotenone (40 to 50 lb. per acre) — *or* — 5-percent DDT (35 to 40 lb. per acre)	1 to 2 pints 40-percent nicotine sulfate in 100 gal. soapy water — *or* — Tetraethyl pyrophosphate emulsion concentrate — *or* — 1½ lb. 15-percent wettable parathion in 100 gal. water	Use nicotine dust or spray only when temperature is above 70° F. Use according to manufacturer's directions. *CAUTION: Do not use on edible portions of vegetables within 30 days of harvest.* Recommended for pea aphids only. *CAUTION: Do not use on pea vines that will be fed to cattle.*
Blister beetles	5-percent DDT	2 lb. 50-percent wettable DDT in 100 gal. water — *or* — 1 qt. 25-percent emulsifiable DDT in 100 gal. water	Apply whenever beetles are present.
Cutworms	5-percent DDT — *or* — 5-percent chlordane	Use DDT and chlordane at concentrations to provide 1 lb. of actual insecticide to 100 gal. water.	Apply on ground around newly transplanted tomato and cabbage plants.
Flea beetles	5-percent DDT	Use sprays given above for blister beetles.	Apply whenever beetles are present or injury is evident.
Grasshoppers	5-percent chlordane — *or* — 10-percent toxaphene	2 lb. 50-percent wettable chlordane in 100 gal. water — *or* — 4 lb. 50-percent wettable toxaphene in 100 gal. water — *or* — Emulsifiable concentrates of either used according to directions on container	Treat grasshoppers in margins of field before they move to crops. Low-gallonage sprays of chlordane and toxaphene are effective against grasshoppers.
White grubs and Wireworms	(No recommendations)	(No recommendations)	

Cabbage Insects

Cabbage worms (3 species)	3- to 5-percent DDT — *or* — 1-percent parathion — *or* — 0.75-percent rotenone	Use sprays given for blister beetles, p. 8. — *or* — Use parathion spray given for aphids, p. 8. — *or* — Use emulsifiable rotenone concentrate according to directions on container.	Begin treatment when worms first appear and repeat at 10-day intervals until three applications have been made. Use rotenone after heads are well formed.
Cabbage maggot	5-percent chlordane	Use wettable chlordane and emulsifiable concentrate at a dilution to provide 1 lb. of actual insecticide in 100 gal. water.	Apply ⅓ pint of spray to each plant. Treat soil around main stem shortly after transplanting. Repeat treatment in 1 week if maggot eggs are numerous.
Aphids	See treatment given on p. 8.		NOTE: DDT applied for worm control may intensify aphid problem since DDT kills parasites and predators that attack aphids. But nicotine or tetraethyl pyrophosphate may be combined with regular DDT sprays to control aphids.

Potato Insects

Leafhoppers	3- to 5-percent DDT	Use DDT sprays given for blister beetles, p. 8.	Begin treatment as soon as adult leafhoppers appear on the foliage. Make 4 applications spacing them 10 to 14 days apart. Parathion is poisonous to leafhoppers but does not afford the long protection given by DDT.
Colorado potato beetles	Use treatment given for blister beetles, p. 8		One or two treatments should eliminate adults and larvae.
Flea beetles	Use treatment given for blister beetles, p. 8.		Treat young potatoes as soon as beetles or their damage appear.
Aphids	See treatment given on p. 8.		Nicotine or tetraethyl pyrophosphate may be combined with regular DDT sprays.
Potato stalk borer	(No recommendations)	(No recommendations)	

Sweet-Corn Insects

European corn borer	5-percent DDT (40 lb. per acre) — *or* — 40-percent Ryania (40 lb. per acre)	3 lb. 50-percent wettable DDT plus ⅓ lb. wetting agent in 100 gal. water — *or* — 3 qt. 25-percent emulsifiable DDT in 100 gal. water 6 lb. pure Ryania stems plus ⅓ lb. wetting agent in 100 gal. water	On market corn varieties, begin treatment with first egg hatching (about June 15 for first-generation borers and Aug. 15 for second-generation). Repeat treatment every 5 days until four have been made. Apply dust or spray on whorl (curl) of young plants and on ear zone of older plants. (*For more information see Illinois Circular 646*)
Corn earworm	5-percent DDT	Inject ½ medicine dropperful of medicinal oil into silk channel after silks are dry.	Dust silks every 3 days until 4 applications have been made, starting when silks first appear.
Stalk borer	(No recommendations)	(No recommendations)	
Seed corn maggot	(No recommendations)	(No recommendations)	

Dust and Spray Formulas — Continued

Insect	DUST	SPRAY	Remarks
		Tomato Insects	
Hornworms	5-percent DDT	Use DDT sprays as given for blister beetles, p. 8.	Make one application when feeding is noticed. Refined DDT is less injurious to tomatoes than technical DDT.
Tomato fruitworms	5-percent DDT	Use DDT sprays as given for blister beetles, p. 8.	Apply 3 times, spacing treatments 10 to 14 days apart and starting at first fruit set. Refined DDT is less injurious to tomatoes than technical DDT.
Aphids	See treatment given on p. 8.		
		Vine Crop Insects	
Striped and spotted cucumber beetles	3- to 5-percent refined grade DDT — *or* — 0.75-percent rotenone	No DDT recommendation Use emulsifiable rotenone concentrate as stated on container	Make first application when beetles first appear and repeat as often as necessary to keep plants protected.
Squash vine borers	3- to 5-percent refined grade DDT	Use DDT sprays as given for blister beetles, p. 8.	Apply only to base of main stem where eggs are laid. Treat 4 times, spacing treatments a week apart and starting with appearance of first eggs on main stem (late June to early July).
Squash bugs	10-percent sabadilla — *or* — 5-percent refined grade DDT	(No recommendations)	Apply insecticides only when adults or nymphs are noted on plants. DDT does not kill squash bugs quickly.
		Onion Insects	
Thrips	5-percent DDT — *or* — 1-percent parathion	Use DDT sprays as given for corn borer, p. 9. — *or* — Use parathion spray as given for aphids, p. 8.	Begin treatment when the population of young thrips averages 5 per plant. Apply 4 times, a week apart. CAUTION: *Do not use DDT or parathion on bunching onions.* Rotenone dust or nicotine sulfate sprays are less dangerous to consumers.
Maggots	5-percent chlordane	Use sprays as given for cabbage maggot, p. 9.	Apply to row when onions are about 1 inch high. Repeat in a week if maggot eggs are numerous. Apply spray with low pressure and put on enough to moisten the soil around the plants.
		Bean Insects	
Mexican bean beetles	0.75-percent rotenone — *or* — 1-percent parathion	Use emulsifiable rotenone concentrate as stated on container.	Start treatment when yellow larvae begin to hatch from eggs. Repeat at weekly intervals until 3 applications have been made. Apply to undersurface of leaves. CAUTION: *Do not use parathion after pods have formed.*

Bean Insects—Concluded			
Bean leaf beetles	Use treatments given for Mexican bean beetles. DDT is also effective against bean leaf beetles but not against Mexican bean beetles.		
Leafhopper	3- to 5-percent DDT	Use sprays given for blister beetles, p. 8.	Begin treatment when young leafhoppers are seen on underside of leaves. Apply 4 times at 10- to 14-day intervals. Parathion is poisonous to leafhoppers but does not give the long protection that DDT does.
Bean weevil	(No recommendation for field use)	(No recommendation for field use)	
Asparagus Insects			
Common and spotted asparagus beetles	3- to 5-percent DDT — *or* — 0.75-percent rotenone	Use DDT sprays as given for blister beetles, p. 8. — *or* — Use emulsifiable rotenone concentrate as stated on the container.	Treat as needed to keep insects off spears or foliage. Use rotenone during the cutting season.
Insect Pests of Carrots, Sweet Potatoes, Beets, Spinach, Lettuce, Celery, and Dill			
Tarnished plant bug	3- to 5-percent DDT	Use DDT sprays given for blister beetles, p. 8.	Treat crop as soon as young bugs are noted on plants.
Garden webworm	3- to 5-percent DDT	Use DDT sprays given for blister beetles, p. 8.	Treat crop as soon as worms begin doing damage.
Carrot weevil	(No recommendations)	(No recommendations)	
Carrot leafhoppers	5-percent DDT	Use DDT sprays given for corn borer, p. 9.	Start treatment when plants are 2 to 3 inches tall and repeat each week for 4 weeks.
Sweet potato beetles (Tortoise beetles or "goldbugs")	3- to 5-percent DDT	Use DDT sprays given for blister beetles, p. 8.	Begin treatments as soon as beetles or larvae are noted on foliage.
Sweet potato leaf beetle	3- to 5-percent DDT	Use DDT sprays given for blister beetles, p. 8.	Treat crops as soon as bluish-colored beetles appear. Insecticides are not effective against worms feeding on the roots.

DUSTING AND SPRAYING EQUIPMENT

Dusters are preferred by many growers for applying insecticides because they are faster than sprayers. Dusting, however, is usually less effective than spraying.

Whether you use a hand or a power duster, apply the dust in a way to cover the plants thoroughly. If you use power equipment, you will need two dust nozzles to the row for most vegetable crops. One nozzle to the row, however, may be enough on such crops as cabbage, onions, and carrots.

Sprayers can be used throughout the day while the use of dusters is limited to periods of low wind velocity. An insecticide applied in a spray sticks to the leaves better than one applied in a dust.

Power sprayers which apply 50 to 200 gallons of spray to the acre give better insect control than the new low-pressure (weed) sprayers which apply only 5 to 15 gallons of spray to the acre. If a low-gallonage weed sprayer is employed, use the required amount of insecticide in whatever volume of water is used to the acre.

For information concerning the control of any insects not included in this circular, write Entomologist, State Natural History Survey, Natural Resources Building, Urbana, Illinois.

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